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# NASA TECH BRIEF

*Lewis Research Center*



## Resin Additive Improves Performance of High-Temperature Hydrocarbon Lubricants

The lubricating performance of selected naphthenic and paraffinic hydrocarbon lubricants has been significantly improved by the use of a resin additive. Advanced aircraft engines and other highly developed machinery show a continuing trend toward operation at higher speeds and higher temperatures. Bearings and other mechanical components require improved lubricants for operation at these increasingly severe conditions. The solid surfaces in such components must be separated by stable films at high shear rates and high temperatures without deterioration of either the lubricant or the surfaces.

Several lubricants evaluated in a series of screening tests using 25-mm bore angular-contact ball bearings included: (1) synthetic-paraffinic hydrocarbon; (2) super-refined naphthenic mineral oil; (3) super-refined naphthenic mineral oil plus resin additive; and (4) synthetic-paraffinic hydrocarbon plus resin additive.

In the high temperature application, the paraffinic resins, commercially developed as viscous, nonvolatile, stable lubricants for use as hydraulic fluids and low speed industrial gear lubricants, or for blending with such fluids and lubricants to improve viscosity, improve the strength of the thin lubricant film in the Hertzian contacts even though they do not increase the bulk oil viscosity.

One-hundred-hour tests at 590 K and 44,000 rpm were conducted on 25-mm bore angular-contact (maximum Hertz stress 1,509 $GN/m^2$) ball bearings with each of the candidate lubricants. The best of a number of lubricants tested, with regard to film strength and ability to prevent lubrication distress, surface damage, and lubrication related failures of the bearings, proved to be the super-refined naphthenic-mineral oil base blended with 10% by weight of high molecular weight heavy paraffinic resin. Other data suggest that as little as two percent can also be effective.

Addition of the resin permitted the successful completion of 100-hour bearing tests with the formulated lubricants. Without the resin addition to the fluids, the bearings failed considerably short of the 100-hour period, generally at less than 50 hours. Bearing raceway distress such as surface glazing or spalling was reduced or eliminated by the resin addition.

A substantial lubricant film is desirable for preventing metal-to-metal contact. However, where there are asperities, there is some contact, increasing the importance of chemical and physical factors that inhibit welding and reduce friction. The prevention of surface-initiated spalling under glazing conditions and other forms of surface distress could preclude early bearing failure in the thin film region, both elastohydrodynamic and boundary. For example, the performance of the fully formulated naphthenic mineral oil without the resin additive was unsatisfactory under the marginal operating conditions. This deficiency was overcome by the addition of the heavy paraffinic resin.

Conceptually, the resin, a complex long-chain high molecular weight hydrocarbon, preferentially absorbs on the critical lubricated surfaces. Thus, the lubricating properties of a fluid can be substantially improved without adversely affecting the bulk physical properties or reducing the thermal stability of the formulated lubricant. The use of the resin also circumvents the corrosivity and high volatility problems inherent with many chemical additives.

(continued overleaf)

## Notes:

1. The following documentation may be obtained from:

   National Technical Information Service
   Springfield, Virginia 22151
   Single document price $3.00
   (or microfiche $0.95)

   Reference:
   NASA-CR-72615 (N70-22075), High Temperature Lubricant Screening Tests

2. Technical questions may be directed to:

   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B71-10394

## Patent status:

No patent action is contemplated by NASA.

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